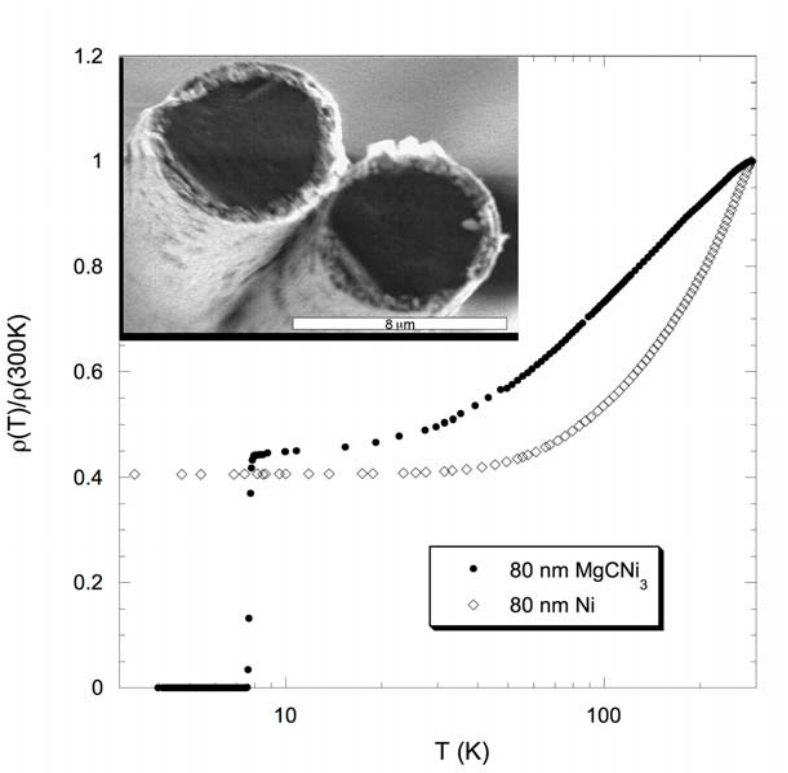
Superconducting Properties of $MgCNi_3$ Micro-fibers

Philip W. Adams* , Louisiana State University, DMR-0204871

- We have developed a process to synthesize superconducting $MgCNi_3$ directly onto 6-8 micron diameter carbon fibers. $MgCNi_3$ is the only known superconducting non-oxide perovskite and has been the subject of intense study since its discovery 2 years ago. Because of its high Ni content, there is speculation that $MgCNi_3$ is near a ferromagnetic instability, though its status as an unconventional superconductor remains unclear.
- The fibers, such as those in the micrograph, can be made in kilometer lengths via a straightforward solid state reaction process. Indeed, the fibers are some of the smallest continuous length superconductors in existence and have a zero temperature critical current density $J_c \sim 5 \times 10^7$ A/cm^2. We are presently studying the anomalous critical current behavior of the fibers.



Normalized resistivity as a function of temperature for a carbon fiber coated with 80 nm of Ni and a fiber with a 80 nm $MgCNi_3$ sheath. Inset: scanning electron micrograph of $MgCNi_3$ fibers.

*In collaboration with Prof. D.P. Young

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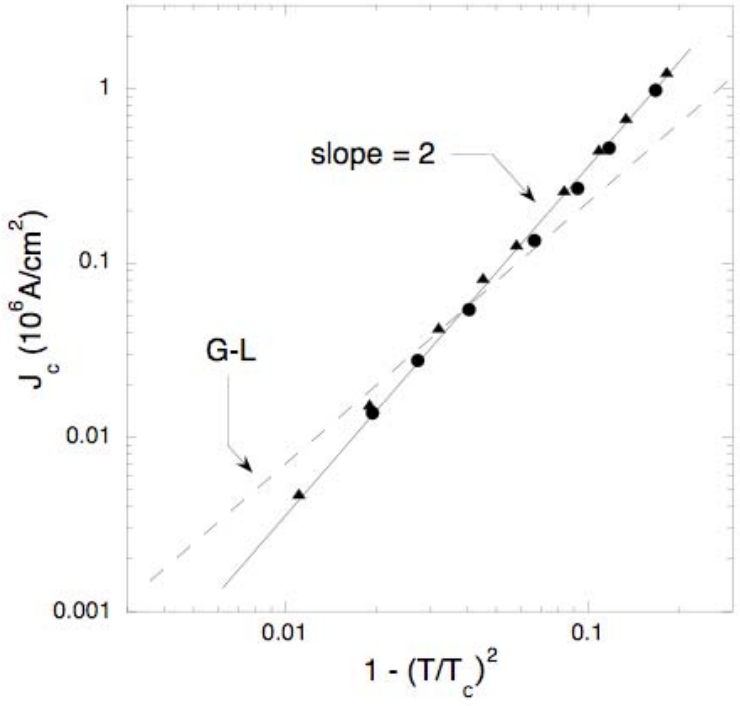
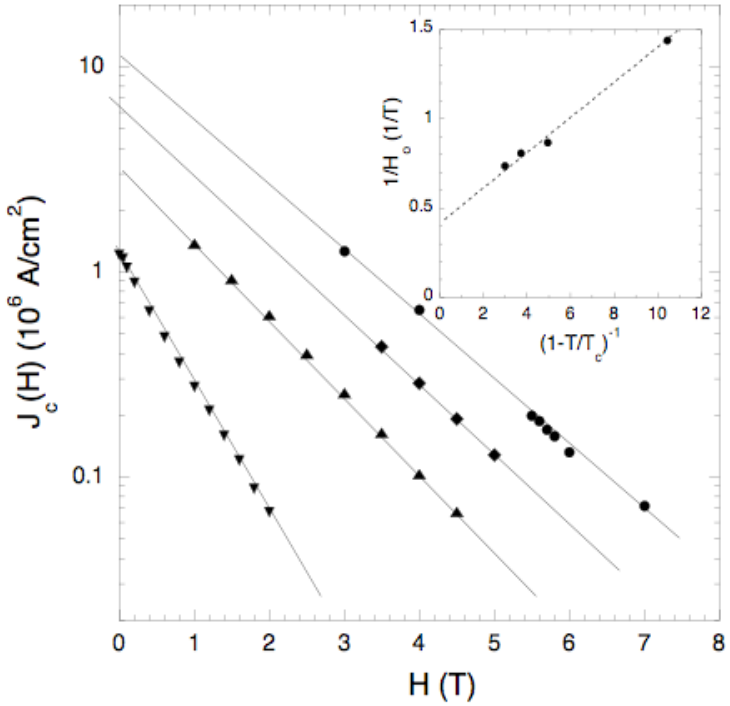


Non--Ginsburg-Landau scaling behavior of the transport critical current in two $MgCNi_3$ microfibers. We believe that the anomalous quadratic scaling is an intrinsic property and not a microstructural effect.



Longitudinal magnetic field dependence of the critical current density at 6.8 K, 6.0 K, 5.5 K, and 5.0 K (bottom to top). Solid lines are exponential fits to the data from which a characteristic decay field H_o is extracted. Inset: characteristic field as a function of the inverse of the reduced temperature.